BACHELOR SLOUGH
ECOSYSTEM RESTORATION
SEDIMENT QUALITY EVALUATION
REPORT

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Prepared by:
Tim Sherman
Mark Siipola

Portland District
Corps of Engineers
CENWP-EC-HR

ACRONYMS

EPA	Environmental Protection Agency
USACE	U.S. Army Corps of Engineers
USFWS	U. S. Fish & Wildlife Service
NOAA	National Oceanic & Atmospheric Administration
SquiRT	Screening Quick Reference Tables (NOAA ReferenceTables)
WDOE	Washington Department of Ecology
ODEQ	Oregon Department of Environmental Quality
WDNR	Washington Department of Natural Resources
DMEF	Dredge Material Evaluation Framework
CRM	Columbia River Mile
NPL	National Priority List
Superfund	An EPA-NPL contaminated site, scheduled for cleanup.
DQO	Data Quality Objectives
NES	Newly Exposed Surface
QA/QC	Quality Assurance/Quality Control
MDL	Method Detection Limit
CoC	Contaminate of concern
TEL	Threshold Effects Level
PWT	Pacific Wood Treating
TOC	Total Organic Carbon
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
MDL	Method Detection Limit
PQL	Practical Quantitation Limit
MRL	Method Reporting Limit
TVS	Total Volatile Solids
PCP	Pentachlorophenol
PWT	Pacific Wood Treatment
MTCA	(Washington State) Model Toxics Control Act
PSDDA	Puget Sound Dredged Disposal Analysis
TEF	Toxicity Equivalent Factor
TEQ	Toxicity Equivalent Quotient
ND	non-detect
pptr	parts per trillion – ng/kg
As	Arsenic
Cd	Cadmium
Ni	Nickel
Cu	Copper
Sb	Thallium
Cr	Chromium
Pb	Lead
Hg	Mercury
Ni	Nickel
Ag	Silver
Zn	Zinc

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BACHELOR SLOUGH ECOSYSTEM RESTORATION
SEDIMENT QUALITY EVALUATION REPORT

ABSTRACT

Bachelor Slough defines the eastern boundary of Bachelor Island (Columbia River Mile 88 and 92). Bachelor Slough empties into Lake River, which bounds the north end of the Island (see figure 1).

The purpose of this sediment evaluation is to determine the suitability of the material within Bachelor Slough for placement in several upland disposal sites on Bachelor Island. A dredging action, proposed by the U.S. Fish and Wildlife Service, Ridgefield National Wildlife Refuge, entails dredging of Bachelor Slough to increase depth and through flow of Columbia River waters in order to enhance in-stream salmonid habitat. Increased depth and flow should also address water temperatures in Bachelor Slough, which currently exceed temperature tolerance of salmonids from approximately mid-summer until fall.

Work is anticipated to be completed by a small pipeline dredge with dredged material placed in diked upland cells with return water discharge via weirs to the Columbia River, Lake River and/or Bachelor Slough. Potential areas for dredged material disposal include an upland portion of Bachelor Slough immediately downstream of the junction of Bachelor Slough and Lake River and inland of the flood protection dike. A second location is an upland site adjacent to the dike near Wigeon Lake. The third location is an old dredged material disposal location on Washington Department of Natural Resources land that abuts the Columbia River, at approximately the center of the island (see figure 2).

Evaluation of the sediment was conducted following procedures set forth in the U.S. Army Corps of Engineers' "Upland" Testing Manual and the "Inland" Testing Manual, developed jointly by the Corps and the U.S. Environmental Protection Agency, to assess dredged material. Guidelines used are those developed to implement the Clean Water Act. These guidelines and associated screening levels are those adopted for use in the Dredge Material Evaluation Framework for the Lower Columbia River Management Area (DMEF), November 1998 (Signed by USACE, EPA, WDOE, ODEQ and WDNR).

A total of ten (10) sediment samples were collected along the length of Bachelor Slough, June 3, 2003. All samples were submitted for physical analyses, including total volatile solids. Samples were, also, analyzed for metals (10 inorganic), total organic carbon, pesticides and polychlorinated biphenyls, phenols, phthalates, miscellaneous extractables and polynuclear aromatic hydrocarbon, with five (5) samples selected for dioxin/furan analyses. One (1) sample was split in the field and submitted to the lab, as a blind duplicate, for quality control purposes.

The sampling plan stated that gravity core samples would be attempted, if material was suitable, however, the material was determined not suitable for gravity coring, due to high sand content and a surface sampler was used. One (1) gravity core sample was collected

from the site that contained the most fine-grained material (25.1% < 230 sieve), with a penetration of 13.5 inches.

Although it was determined that gravity coring was not possible, because of the high sand content of the proposed dredging prism, these surface samples provide adequate characterization of the dredging prism, due to the high sand content and homogeneous nature of the material represented.

The physical analyses indicted: two (2) of the samples exceeded 20% fines (BACH-BC-07 & BACH-GC-10), with <2.1% volatile solids. Three (3) samples were classified as "poorly graded sand", three (3) as "poorly graded sand with silt" and four (4) samples as "silty sand." Mean grain size for all the samples is 0.16 mm, with 0.0% gravel, 88.6% (100%-74.9% range) sand and 11.4% (0%-25.1% range) fines. Mean volatile solids were 1.23% for all the samples, with a 0.57% to 2.07% range.

The chemical analyses indicated low levels of metals, low levels of several phenol & phthalate compounds, very low levels of PAHs & Dioxins/furans.

The sediment represented by this sampling event is determined to be suitable for unconfined, in-water or upland placement without further characterization.

INTRODUCTION

This report characterizes the sediment proposed for dredging within Bachelor Slough channel for the purposes of dredging and disposal. The sampling and analysis objectives are stated in the Sampling and Analysis Plan (SAP June 2003), and are also listed below. This report will outline the procedures used to accomplish these objectives and include any changes made to the objectives due to field conditions.

Sampling and Analysis Objectives

Characterizing of the sediment was conducted following procedures set forth in the U.S. Army Corps of Engineers' Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities – (Upland) Testing Manual and the Inland Testing Manual, developed jointly by the Corps and the U.S. Environmental Protection Agency to assess dredged material. Guidelines used are those developed to implement the Clean Water Act. These guidelines and associated screening levels are those adopted for use in the Dredge Material Evaluation Framework for the Lower Columbia River Management Area, November 1998 (Signed by USACE, EPA, WDOE, ODEQ and WDNR).

- Physical and chemical analyses will be conducted on the samples representing the dredging prism. Although it was determined that gravity coring was not possible, because of the high sand content of the proposed dredging prism, these surface samples provide adequate characterization of the dredging prism, due to the high sand content and homogeneous nature of the material represented.

- Collect, handle and analyze representative sediment of the purposed dredging prism, in accordance with protocols and Quality Assurance/Quality Control (QA/QC) requirements.

- Characterize sediments to be dredged for evaluation of environmental impact.

- Conduct physical and chemical characterization only for this sediment evaluation, unless further characterization is desired under the Tier III DMEF bioassay protocol.

PREVIOUS STUDIES

Previous sediment and fish tissue were collected near the former Pacific Wood Treatment (PWT) facility, which is located immediately south of Carty Lake, east of Lake River. Contaminants documented onsite included pentachlorophenol (PCP), volatile and semi-volatile organics, copper, chromium, and arsenic. Bachelor Slough sediments were used as reference material for this study, with no results above detection limits. In a separate event, fish tissue and sediment samples, collected near the PWT site in 1991, indicated dioxin/furan contamination present.

Due to the proximity of the PWT site, to Bachelor Slough, all samples were submitted for a full suite of contaminates, with 5 of the 10 samples collected submitted for dioxin/furans.

CURRENT SAMPLING EVENT/DISCUSSION

A total of ten (10) sediment samples were collected along the length of Bachelor Slough, June 3, 2003. All samples were submitted for physical analyses, including total volatile solids. Samples were, also, analyzed for metals (10 inorganic), total organic carbon, pesticides and polychlorinated biphenyls, phenols, phthalates, miscellaneous extractables and polynuclear aromatic hydrocarbon, with five (5) samples selected for dioxin/furan analyses. One (1) sample was split in the field and submitted to the lab, as a blind duplicate, for quality control purposes.

Table 1. Sample Location Coordinates
(NAD 83, Oregon State Plane North)

BACH-BC-01 BACH-BC-A (Field Blind Dup)	45º 49' 17.5" 122º 45' 31.1"	BACH-BC-02	45º 48' 30.4" 122º 45' 52.2"
BACH-BC-03	45º 47' 55.5" 122º 46' 08.3"	BACH-BC-04	45º 47' 40.7" 122º 46' 15.1"
BACH-BC-05	45º 47' 36.6" 122º 46' 27.2"	BACH-BC-06	45º 48' 12.1" 122º 46' 03.1"
BACH-BC-07	45º 48' 43.6" 122º 45' 42.6"	BACH-BC-08	45º 49' 07.2" 122º 45' 33.3"
BACH-BC-09	45º 49' 40.6" 122º 45' 33.7"	BACH-GC-10	45º 49' 41.2" 122º 45' 33.9"

Nine (9) samples were collected using a box-core sampling device and one (1) sample with a gravity-core sampler, with a 13.5" penetration. The sampling plan stated that gravity core samples would be attempted, if material was suitable, however, the material was not suitable for gravity coring and a surface sampler was used. Although it was determined that gravity coring was not possible, because of the high sand content of the proposed dredging prism, these surface samples provide adequate characterization of the dredging prism, due to the high sand content and homogeneous nature of the material represented.

RESULTS

Physical and Volatile Solids (ASTM methods).

Ten (10) samples were submitted for physical and volatile solids analyses, with data presented in Table 2. Two (2) of the samples exceeded 20% fines (BACH-BC-07 & BACH-GC-10), but were <2.1% volatile solids. Three (3) samples were classified as "poorly graded sand", three (3) as "poorly graded sand with silt" and four (4) samples as "silty sand." Mean grain size for all the samples is 0.16 mm, with 0.0% gravel, 88.6% (100%-74.9% range) sand and 11.4% (0%-25.1% range) fines. Mean volatile solids were 1.23% for all the samples, with a 0.57% to 2.07% range.

Metals (EPA method SW846-6020/7471), Total Organic Carbon (TOC) (EPA method SW846-9060).
Ten (10) samples were submitted for testing, with data presented in Table 3. The TOC ranged from 616 to 8,280 mg/kg in the samples, with a mean value of 3655 mg/kg. None of the metals tested, exceeded 40% of their respective DMEF screening levels.

Pesticides/PCBs (EPA method SW846-8081A/8082), Phenols, Phthalates and Miscellaneous Extractables (EPA method SW846-8270C).
Ten (10) samples, with one (1) additional blind duplicate, were tested for pesticide/PCBs, phenols, phthalates and miscellaneous extractables, with data presented in Table 4. No pesticides (including DDT) were found at the MDL in any of the samples. Aroclor 1242 was found in BACH-GC-10 at19.3 ppb & BACH-BC-A at 22.5 ppb (SL for total PCB = 130 ppb). Aroclor 1242 detected in BACH-BC-A was not confirmed in its blind duplicate, BACH-BG-01. Four (4) phenols, five (5) phthalates and one (1) miscellaneous extractable compound were detected at low levels; none approached the DMEF screening levels in any of the samples.

Polynuclear Aromatic Hydrocarbons (PAH)(EPA method SW846-8270C).
Ten (10) samples, with one (1) additional blind duplicate, were tested for low and high molecular weight PAH analytes, with data presented in Table 5. PAHs were detected at very low levels in most of the samples. Total "low molecular weight" PAH analyte levels ranged from non-detect (ND) to 27 ug/kg. Total "high molecular weight" PAH analyte levels ranged from ND to 205 ug/kg.

Dioxins/Furans (EPA method SW846-8290).
Five (5) samples were tested for dioxin/furans, with data presented in Table 6. Dioxin (2,3,7,8-TCDD) and furan (2,3,7,8-TCDF) were not found at the MDL for any of the samples. The Toxicity Equivalency Quotient (TEQ) values are all well below the guidance concentration value; TEQ values ranged from 0.36 to 0.68 ng/kg (pptr).

Guidance used to evaluate dioxin/furan analyses was Puget Sound Dredged Disposal Analysis (PSDDA) Program (Feb 2000) and U.S. EPA Toxicity Equivalency Factors (U.S. EPA 1989; Ahlborg et al. 1994). A bulk sediment 2,3,7,8-tetrachlorodibenzo-p-dioxin concentration of 5 ng/kg, or a total toxic equivalent concentration of 15 ng/kg will trigger the requirement to perform bioaccumulation testing.

CONCLUSION

Collection and evaluation of the sediment data was completed using guidelines from the Dredge Material Evaluation Framework for the Lower Columbia River Management Area (DMEF). The DMEF is a regional manual developed jointly with regional EPA, Corps, Oregon Department of Environmental Quality and Washington Departments of Ecology and Natural Resources. This document is a guideline for implementing the Clean Water Act (40 CFR 230), Section 404 (b)(1). The screening levels used are those adopted for use in the DMEF, November 1998. The DMEF tiered testing approach requires that material in excess of 20% fines and greater than 5% volatile solids, as well as any material with prior history or is suspected ("reason to believe") of being contaminated, be subjected to chemical as well as physical analyses.

A total of ten (10) sediment samples were collected along the length of Bachelor Slough, June 3, 2003. All samples were submitted for physical dredge analyses and chemically analyzed for metals (10 inorganic), total organic carbon, pesticides, polychlorinated biphenyls, phenols, phthalates, miscellaneous extractables and polynuclear aromatic hydrocarbon, with five (5) samples selected for dioxin/furan analyses. One (1) sample was split in the field and submitted to the lab, as a blind duplicate, for quality control purposes. Of the contaminants detected none approached their respective DMEF screening levels, in any of the samples.

All sediment is determined to be suitable for unconfined in-water or upland placement, with return water back to Bachelor Slough, Lake River or the Columbia River, without further characterization.

REFERENCES

1. U.S. Army Corps of Engineers, Portland District and Seattle District; U.S. Environmental Protection Agency, Region 10; Oregon Department of Environmental Quality; Washington State Department of Natural Resources and Department of Ecology. 1998 Final. Dredge Material Evaluation Framework for the Lower Columbia River Management Area.

2. U.S. Environmental Protection Agency and U.S. Army Corps of Engineers. February 1998. Evaluation of Dredged Material Proposed for Discharge in Inland and Near Coastal Waters - Testing Manual (referred to as the "Inland Testing Manual").

3. U.S. Army Corps of Engineers. January 2003. Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities - Testing Manual (referred to as the "Upland Testing Manual").

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Table 2. Physical Analysis & Volatile Solids

Bachelor Slough Sampled June 3, 2003

Sample I.D.	Grain Size (mm)		Percent			
	Median	Mean	Gravel	Sand	Silt/Clay	Volatile Solids
BACH-BC-01	0.11	0.09	0.00	83.9	16.1	1.68
BACH-BC-02	0.11	0.09	0.00	88.4	11.6	1.21
BACH-BC-03	0.25	0.19	0.00	99.9	0.1	0.60
BACH-BC-04	0.14	0.13	0.00	92.4	7.6	0.77
BACH-BC-05	0.33	0.31	0.00	100	0.0	0.39
BACH-BC-06	0.70	0.40	0.00	99.2	0.8	0.57
BACH-BC-07	0.09	0.07	0.00	77.7	22.3	2.07
BACH-BC-08	0.15	0.15	0.00	88.9	11.1	1.20
BACH-BC-09	0.10	0.07	0.00	80.7	19.3	1.94
BACH-GC-10	0.09	0.07	0.00	74.9	25.1	1.84
Mean	0.21	0.16	0.00	88.6	11.4	1.23
Minimum	0.09	0.07	0.00	74.9	0.0	0.39
Maximum	0.70	0.40	0.00	100	25.1	2.07

Table 3. Inorganic Metals and TOC

Bachelor Slough Sampled June 3, 2003

Sample I.D.	As	Sb	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	TOC
	mg/kg (ppm)										
BACH-BC-01	4.36	1.78 J B2	0.266 J	11.5	20.1	9.88	0.094	12.3 B1	0.099 J	81.9	4390
BACH-BC-02	3.5	1.24 J B2	0.207 J	12.7	25.1	9.99	0.062	13.3 B2	0.095 J	85	3890
BACH-BC-03	2.14	0.78 J B2	<0.050	6.3	12.8	4.88	0.018 J	8.5 B1	0.086 J	43.5	616
BACH-BC-04	2.34	0.72 J B2	<0.055	9.6	14.4	5.78	0.037	11.1 B1	0.067 J	48.7	1690
BACH-BC-05	1.24	0.48 J B1	<0.050	7.0	7.6	3.59	0.008 J	6.98 B1	0.029 J	29.6	408
BACH-BC-06	2.89	0.16 J B1	0.077 J	4.1	12.6	3.34	0.015 J	6.01 B1	0.027 J	25.8	655
BACH-BC-07	4.22	0.96 J B2	0.297 J	16.1	22.0	13.3	0.061	13.3B1	2.33	93.8	5820
BACH-BC-08	6.86	0.67 J B2	0.145 J	11.9	17.6	8.66	0.077	12.2 B1	0.093 J	74.0	3130
BACH-BC-09	2.97	0.62 J B1	0.263 J	11.8	17.4	9.06	0.065	11.8 B1	0.107 J	79.6	7250
BACH-BC-10	3.22	0.72 J B2	0.258 J	14.3	22.7	127	0.077	13.1 B2	0.109 J	91	8280
BACH-BC-A	3.28	0.53 J B1	0.168 J	11.6	16.9	8.99	0.034	12.0 B1	0.094 J	76	4070
Mean	3.37	0.79	0.153	10.6	17.2	18.6	0.0498	10.96	0.28	66.3	3655
Minimum	1.24	0.16	ND	4.1	7.6	3.34	0.018	6.0	0.027	25.8	616
Maximum	6.86	1.78	0.266	16.1	25.1	127	0.094	13.3	2.33	91	8280
Screening level (SL)	57	150	5.1	-	390	450	0.41	140	6.1	410	

BACH-BC-A is blind duplicate of BACH-BC-01
J = Estimated value (reported values are above the MDL, but below the PQL).
B1 = Low-level contamination was present in the method blank (reported level was < 10 times blank concentration).
B2 = Low-level contamination was present in the method blank (reported level was > 10 times blank concentration).
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit). Symbol (-) = no screening level established.

Table 4. Pesticides, *PCBs, Phenols, Phthalates & Misc. Extractables

Bachelor Slough Sampled June 3, 2003

Sample I.D.	Pesticides				Phenol				Phthalates					Misc. Extractables
	ug/kg (ppb)													
	4,4'-DDD	4,4'-DDE	4,4'-DDT	Total DDT	Phenol	2-methyl phenol	3&4 Methyl phenol	Pentachloro phenol	bis(2-Ethylhexyl) phthalate	Butyl benzyl-phthalate	Di-n-butyl phthalate	Di-n-octyl phthalate	Diethyl phthalate	Benzoic Acid
BACH-BC-01	<1.4	<1.4	<1.4	ND	<9.9	<9.9	<9.9	<9.9	15.4 J B1	13.5 J	22 B1	<9.9	<9.9	49.2
BACH-BC-02	<1.4	<1.4	<1.4	ND	12.8 J	14.5 J	106	38.9	206 B2	103	178 B2	23	19.7	145
BACH-BC-03	<1.4	<1.4	<1.4	ND	<7.8	<7.8	<15.6	<7.8	<7.8	11.5J	12.8J B1	<7.8	<7.8	38.9
BACH-BC-04	<1.4	<1.4	<1.4	ND	<8.3	<8.3	<16.5	<8.3	<8.3	<10.3	14.3J B1	<8.3	<8.3	41.2
BACH-BC-05	<1.4	<1.4	<1.4	ND	<8.4	<8.4	<16.8	<8.4	<8.4	<10.5	15.6J B1	<8.4	<8.4	41.9
BACH-BC-06	<1.4	<1.4	<1.4	ND	<8.2	<8.2	<16.2	<8.2	<8.2	<10.1	14.1J B1	<8.2	<8.2	40.5
BACH-BC-07	<1.4	<1.4	<1.4	ND	<9.4	<9.4	<18.7	<9.4	<9.4	<11.7	14.3J B1	<9.4	<9.4	46.7
BACH-BC-08	<1.4	<1.4	<1.4	ND	<9.0	<9.0	<18.0	<9.0	9.83J B1	<11.2	16.1J B1	<9.0	<9.0	44.9
BACH-BC-09	<1.4	<1.4	<1.4	ND	<9.7	<9.7	34J	<9.7	<9.7	<12.1	<9.7	<9.7	<9.7	34
BACH-BC-10	<1.4	<1.4	<1.4	ND	<9.6	<9.6	<19.0	<9.6	<9.6	<11.9	<9.6	<9.6	<9.6	ND
BACH-BC-A	<1.4	<1.4	<1.4	ND	<8.7	<8.7	62.5	<8.7	<8.7	<11.9	<8.7	<8.7	<8.7	62.5
Mean				ND	1.2	1.3	18.4	3.5	21.0	11.6	26.1	2.1	1.8	49.5
Minimum				ND	ND	ND	34	ND	9.83	13.5	12.8	ND	ND	34
Maximum				ND	12.8	14.5	106	38.9	206	103	178	23	19.7	145
Screen level (SL)				6.9	420	63	670	400	8300	670	5100	6200	1200	650

*The **PCB,** Aroclor 1242, was found in BACH-GC-10 at 19.3 ppb & BACH-BC-A at 22.5 ppb (SL for total PCB = 130 ppb).
J = Estimated value (reported values are above the MDL, but below the PQL).
B1 = Low-level contamination was present in the method blank (reported level was < 10 times blank concentration).
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit). BACH-BC-A is blind duplicate of BACH-BC-01.

Table 5. Polynuclear Aromatic Hydrocarbons (PAHs)
Low Molecular Weight Analytes
ug/kg (ppb)
Bachelor Slough Sampled June 3, 2003

Sample I.D.	Acenaphthene	Acenaphthylene	Anthracene	Fluorene	2-Methyl naphthalene	Naphthalene	Phen-anthrene	Total Low PAHs
BACH-BC-01	1.35 J	1.2 J	1.55 J	1.2 J	<2.46	2.38 J	5.47	13
BACH-BC-02	<0.89	<0.89	1.89	2.05	<2.22	1.51 J	21	26.5
BACH-BC-03	<0.78	<0.78	<0.78	<0.78	<2.1	<0.78	<0.78	ND
BACH-BC-04	<0.83	<0.83	<0.83	<0.83	<2.1	<0.83	<0.83	ND
BACH-BC-05	<1.1	<1.1	<1.1	<1.1	<2.1	<1.1	<1.1	ND
BACH-BC-06	<0.82	<0.82	<0.82	<0.82	<2.1	<0.82	<0.82	ND
BACH-BC-07	1.28J	5.21	2	1.04J	<2.1	1.46J	5.16	16
BACH-BC-08	<0.9	1.45J	<0.9	<9.0	<2.3	0.96J	3.84	6.3
BACH-BC-09	1.25J	0.99J	1.31J	1.39J	<2.5	1.91J	7.37	14.2
BACH-BC-10	<0.95	1.76J	4.11	1.06J	<2.4	1.77J	6.08	14.8
BACH-BC-A	0.93J	1.52J	2.13	1.14J	<2.2	<0.87	9.1	15.1
Mean	0.44	1.1	0.91	0.72	ND	0.82	5.3	9.6
Minimum	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	1.35	1.76	4.11	205	ND	2.38	7.37	26.5
Screen level (SL)	500	560	960	540	670	2100	1500	5200

BACH-BC-A is blind duplicate of BACH-BC-01
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)
J = Estimated value (reported values are above the MDL, but below the PQL).

Table 5 (cont'd). Polynuclear Aromatic Hydrocarbons (PAHs)
High Molecular Weight Analytes
ug/kg (ppb)
Bachelor Slough Sampled June 3, 2003

Sample I.D.	Benzo(a)-anthracene	Benzo-fluro-anthenes	Benzo-(g,h,i)-perylene	Chrysene	Pyrene	Benzo(a)-pyrene	Indeno-(1,2,3-cd)-pyrene	Dibenz(a,h) anthracene	Fluor-anthene	Total High PAHs
BACH-BC-01	6.32	15.3	6.23	10.4	12.8	8.93	4.89	1.7 J	11.3	78
BACH-BC-02	10.5	18.9	7.54	14.8	39.6	8.38	7.29	<1.16	35.6	81
BACH-BC-03	<1.1	<2.0	<0.78	<0.78	2.13	1.43J	<1.1	<1.1	1.83	5.5
BACH-BC-04	<1.1	<2.0	<1.1	<1.1	<0.84	<1.1	<1.1	<1.1	<0.84	ND
BACH-BC-05	<1.1	<2.0	<1.1	<1.1	<0.82	<1.1	<1.1	<1.1	<0.82	ND
BACH-BC-06	<1.1	2.4J	0.94J	<1.1	<0.82	1.42J	<1.1	<1.1	<0.82	5
BACH-BC-07	13.1	28.6	17.9	18.3	41.6	20	12.6	4.21	26.7	183
BACH-BC-08	5.19	11.9	5.66	6.51	7.45	7.2	3.98	<1.2	7.68	55.6
BACH-BC-09	11.1	23	9.2	21.9	21.3	12.9	7.31	3.66	20.4	130.8
BACH-BC-10	16.2	47.2	13.6	44.8	26.3	15.1	13.5	5.17	23.3	205.2
BACH-BC-A	11.9	19.5	7.61	12.6	23.7	10.4	5.64	3.2	22.2	116.8
Mean	6.8	15.2	14.4	11.8	15.9	7.8	16.8	1.6	13.5	78.9
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	13.1	47.2	13.6	44.8	41.6	12.9	13.5	5.17	35.6	205.2
Screen level (SL)	1300	3200	670	1400	2600	1600	600	230	1700	12000

BACH-BC-A is blind duplicate of BACH-BC-01
J = Estimated value (reported values are above the MDL, but below the PQL).
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).

Table 6. Dioxins/Furans
Bachelor Slough Sampled June 3, 2003
(ng/kg, pptr)

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*
BACH-BC-02 - Dioxin	2,3,7,8-TCDD	<0.34	<0.17	1.0	0.17	A bulk sediment 2,3,7,8-tetrachlorodibenzo-p-dioxin concentration of 5 ng/kg, or a total toxic equivalent concentration of 15 ng/kg will trigger the requirement to perform bioaccumulation testing.
	1,2,3,7,8-PeCDD	<0.18	<0.09	0.5	0.045	
	1,2,3,4,7,8-HxCDD	<0.29	<0.15	0.1	0.015	
	1,2,3,6,7,8-HxCDD	<0.43	<0.22	0.1	0.022	
	1,2,3,7,8,9-HxCDD	<0.44	<0.22	0.1	0.022	
	1,2,3,4,6,7,8-HpCDD	5.0 J		0.01	0.05	
	OCDD	44 B		0.001	0.044	
BACH-BC-02 - Furan	2,3,7,8-TCDF	<0.40	<0.20	0.1	0.02	
	1,2,3,7,8-PeCDF	<0.32	<0.16	0.05	0.008	
	2,3,4,7,8-PeCDF	<0.29	<0.15	0.05	0.0075	
	1,2,3,4,7,8-HxCDF	<0.15	<0.08	0.1	0.008	
	1,2,3,6,7,8-HxCDF	<0.20	<0.10	0.1	0.01	
	2,3,4,6,7,8-HxCDF	<0.23	<0.12	0.1	0.012	
	1,2,3,7,8,9-HxCDF	<0.12	<0.06	0.1	0.006	
	1,2,3,4,6,7,8-HpCDF	<1.3	<0.65	0.01	0.0065	
	1,2,3,4,7,8,9-HpCDF	<0.32	<0.16	0.01	0.0016	
	OCDF	<2.3	<1.15	0.001	0.00115	
BACH-BC-02 - Totals	Total TCDF	<0.40	<0.20	0	0	
	Total PeDCF	<0.29	<0.15	0	0	
	Total HxCDF	<0.44	<0.22	0	0	
	Total HpCDF	<1.3	<0.65	0	0	
	Total TCDD	<0.34	<0.17	0	0	
	Total PeCDD	<0.18	<0.09	0	0	
	Total HxCDD	<0.83	<0.44	0	0	
	Total HpCDD	13		0	0	
Total Dioxins/Furans TEQ					**0.43335 ng/kg**	**<15 ng/kg**

J Estimate result. Result is < reporting limit. B Method blank contamination.
MDL = Method Detection Limit
TEQ = Toxicity Equivalency Quotient
TEF = Toxicity Equivalency Factors
*Guidance = Puget Sound Dredged Disposal Analysis (PSDDA) Program (Feb 2000) and U.S. EPA Toxicity Equivalency Factors (U.S. EPA 1989; Ahlborg et al. 1994)

Table 6 (cont'd). Dioxins/Furans
Bachelor Slough Sampled June 3, 2003
(ng/kg, pptr)

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*
BACH-BC-04 - Dioxin	2,3,7,8-TCDD	<0.25	<0.13	1.0	0.09	A bulk sediment 2,3,7,8-tetrachlorodibenzo-p-dioxin concentration of 5 ng/kg, or a total toxic equivalent concentration of 15 ng/kg will trigger the requirement to perform bioaccumulation testing.
	1,2,3,7,8-PeCDD	<0.18	<0.09	0.5	0.045	
	1,2,3,4,7,8-HxCDD	<0.25	<0.13	0.1	0.0075	
	1,2,3,6,7,8-HxCDD	<0.39	<0.20	0.1	0.020	
	1,2,3,7,8,9-HxCDD	<0.39	<0.20	0.1	0.020	
	1,2,3,4,6,7,8-HpCDD	6.1 J		0.01	0.061	
	OCDD	48 B		0.001	0.048	
BACH-BC-04 - Furan	2,3,7,8-TCDF	<0.24	<0.12	0.1	0.012	
	1,2,3,7,8-PeCDF	<0.22	<0.11	0.05	0.008	
	2,3,4,7,8-PeCDF	<0.22	<0.11	0.05	0.0075	
	1,2,3,4,7,8-HxCDF	<0.30	<0.15	0.1	0.008	
	1,2,3,6,7,8-HxCDF	<0.19	<0.10	0.1	0.01	
	2,3,4,6,7,8-HxCDF	<0.10	<0.05	0.1	0.012	
	1,2,3,7,8,9-HxCDF	<0.12	<0.06	0.1	0.006	
	1,2,3,4,6,7,8-HpCDF	<1.9	<0.95	0.01	0.0065	
	1,2,3,4,7,8,9-HpCDF	<0.18	<0.09	0.01	0.0016	
	OCDF	<3.6	<1.8	0.001	0.00115	
BACH-BC-04 - Totals	Total TCDF	<0.27	<0.24	0	0	
	Total PeDCF	<0.22	<0.11	0	0	
	Total HxCDF	<0.86	<0.43	0	0	
	Total HpCDF	<2.7	<1.35	0	0	
	Total TCDD	<0.25	<0.13	0	0	
	Total PeCDD	<0.18	<0.09	0	0	
	Total HxCDD	<0.79	<0.40	0	0	
	Total HpCDD	12		0	0	
Total Dioxins/Furans TEQ					**0.36425 ng/kg**	**<15 ng/kg**

J Estimate result. Result is < reporting limit. B Method blank contamination.
MDL = Method Detection Limit
TEQ = Toxicity Equivalency Quotient
TEF = Toxicity Equivalency Factors
*Guidance = Puget Sound Dredged Disposal Analysis (PSDDA) Program (Feb 2000) and U.S. EPA Toxicity Equivalency Factors (U.S. EPA 1989; Ahlborg et al. 1994)

Table 6 (cont'd). Dioxins/Furans
Bachelor Slough Sampled June 3, 2003
(ng/kg, pptr)

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*
BACH-BC-07- Dioxin	2,3,7,8-TCDD	<0.25	<0.13	1.0	0.13	
	1,2,3,7,8-PeCDD	<0.19	<0.10	0.5	0.095	
	1,2,3,4,7,8-HxCDD	<0.22	<0.11	0.1	0.011	
	1,2,3,6,7,8-HxCDD	<0.55	<0.28	0.1	0.028	
	1,2,3,7,8,9-HxCDD	<0.49	<0.25	0.1	0.025	
	1,2,3,4,6,7,8-HpCDD	8.1		0.01	0.081	
	OCDD	79 B		0.001	0.079	
BACH-BC-07- Furan	2,3,7,8-TCDF	<0.55	<0.28	0.1	0.028	A bulk sediment 2,3,7,8-tetrachlorodibenzo-p-dioxin concentration of 5 ng/kg, or a total toxic equivalent concentration of 15 ng/kg will trigger the requirement to perform bioaccumulation testing.
	1,2,3,7,8-PeCDF	<0.24	<0.12	0.05	0.006	
	2,3,4,7,8-PeCDF	<0.19	<0.10	0.05	0.005	
	1,2,3,4,7,8-HxCDF	<0.39	<0.20	0.1	0.02	
	1,2,3,6,7,8-HxCDF	<0.22	<0.11	0.1	0.011	
	2,3,4,6,7,8-HxCDF	<0.13	<0.07	0.1	0.007	
	1,2,3,7,8,9-HxCDF	<0.15	<0.08	0.1	0.008	
	1,2,3,4,6,7,8-HpCDF	<1.9	<0.95	0.01	0.0095	
	1,2,3,4,7,8,9-HpCDF	<0.28	<0.16	0.01	0.0016	
	OCDF	<2.8	<1.4	0.001	0.0007	
BACH-BC-07- Totals	Total TCDF	<0.55	<0.20	0	0	
	Total PeDCF	<0.30	<0.15	0	0	
	Total HxCDF	<0.76	<0.22	0	0	
	Total HpCDF	<1.9	<0.65	0	0	
	Total TCDD	<0.49	<0.17	0	0	
	Total PeCDD	<0.19	<0.09	0	0	
	Total HxCDD	<1.3	<0.44	0	0	
	Total HpCDD	16		0	0	
Total Dioxins/Furans TEQ					**0.5458 ng/kg**	**<15 ng/kg**

J Estimate result. Result is < reporting limit. B Method blank contamination.
MDL = Method Detection Limit
TEQ = Toxicity Equivalency Quotient
TEF = Toxicity Equivalency Factors
*Guidance = Puget Sound Dredged Disposal Analysis (PSDDA) Program (Feb 2000) and U.S. EPA Toxicity Equivalency Factors (U.S. EPA 1989; Ahlborg et al. 1994)

Table 6 (cont'd). Dioxins/Furans
Bachelor Slough Sampled June 3, 2003
(ng/kg, pptr)

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*
BACH-BC-08 - Dioxin	2,3,7,8-TCDD	<0.15	<0.08	1.0	0.008	A bulk sediment 2,3,7,8-tetrachlorodibenzo-p-dioxin concentration of 5 ng/kg, or a total toxic equivalent concentration of 15 ng/kg will trigger the requirement to perform bioaccumulation testing.
	1,2,3,7,8-PeCDD	<0.13	<0.07	0.5	0.035	
	1,2,3,4,7,8-HxCDD	<0.22	<0.11	0.1	0.011	
	1,2,3,6,7,8-HxCDD	<0.73	<0.37	0.1	0.037	
	1,2,3,7,8,9-HxCDD	<0.45	<0.23	0.1	0.023	
	1,2,3,4,6,7,8-HpCDD	16 J		0.01	0.16	
	OCDD	120 B		0.001	0.12	
BACH-BC-08 - Furan	2,3,7,8-TCDF	<0.40	<0.20	0.1	0.02	
	1,2,3,7,8-PeCDF	<0.32	<0.16	0.05	0.008	
	2,3,4,7,8-PeCDF	<0.29	<0.15	0.05	0.0075	
	1,2,3,4,7,8-HxCDF	<0.15	<0.08	0.1	0.008	
	1,2,3,6,7,8-HxCDF	<0.20	<0.10	0.1	0.01	
	2,3,4,6,7,8-HxCDF	<0.23	<0.12	0.1	0.012	
	1,2,3,7,8,9-HxCDF	<0.12	<0.006	0.1	0.0006	
	1,2,3,4,6,7,8-HpCDF	<1.3	<0.15	0.01	0.0015	
	1,2,3,4,7,8,9-HpCDF	<0.32	<0.16	0.01	0.0016	
	OCDF	<2.3	<1.2	0.001	0.0012	
BACH-BC-08 - Totals	Total TCDF	<0.40	<0.42	0	0	
	Total PeDCF	<0.29	<0.32	0	0	
	Total HxCDF	<0.44	<0.91	0	0	
	Total HpCDF	<1.3	<2.0	0	0	
	Total TCDD	<0.34	<0.24	0	0	
	Total PeCDD	<0.18	<0.13	0	0	
	Total HxCDD	<0.83	<1.6	0	0	
	Total HpCDD	30		0	0	
Total Dioxins/Furans TEQ					**0.4644 ng/kg**	**<15 ng/kg**

J Estimate result. Result is < reporting limit. B Method blank contamination.
MDL = Method Detection Limit
TEQ = Toxicity Equivalency Quotient
TEF = Toxicity Equivalency Factors
*Guidance = Puget Sound Dredged Disposal Analysis (PSDDA) Program (Feb 2000) and U.S. EPA Toxicity Equivalency Factors (U.S. EPA 1989; Ahlborg et al. 1994)

Table 6 (cont'd). Dioxins/Furans
Bachelor Slough Sampled June 3, 2003
(ng/kg, pptr)

Sample I.D.	Dioxin/Furan	Result	½ MDL	TEF	TEQ	Guidance*
BACH-BC-09 - Dioxin	2,3,7,8-TCDD	<0.25	<0.13	1.0	0.13	A bulk sediment 2,3,7,8-tetrachlorodibenzo-p-dioxin concentration of 5 ng/kg, or a total toxic equivalent concentration of 15 ng/kg will trigger the requirement to perform bioaccumulation testing.
	1,2,3,7,8-PeCDD	<0.32	<0.16	0.5	0.08	
	1,2,3,4,7,8-HxCDD	<0.23	<0.12	0.1	0.012	
	1,2,3,6,7,8-HxCDD	<0.78	<0.39	0.1	0.020	
	1,2,3,7,8,9-HxCDD	<0.86	<0.43	0.1	0.022	
	1,2,3,4,6,7,8-HpCDD	13 J		0.01	0.13	
	OCDD	110 B		0.001	0.11	
BACH-BC-09 - Furan	2,3,7,8-TCDF	<0.60	<0.30	0.1	0.03	
	1,2,3,7,8-PeCDF	<0.38	<0.19	0.05	0.019	
	2,3,4,7,8-PeCDF	<0.34	<0.17	0.05	0.0085	
	1,2,3,4,7,8-HxCDF	<0.51	<0.26	0.1	0.026	
	1,2,3,6,7,8-HxCDF	<0.31	<0.16	0.1	0.06	
	2,3,4,6,7,8-HxCDF	<0.14	<0.07	0.1	0.007	
	1,2,3,7,8,9-HxCDF	<0.25	<0.13	0.1	0.013	
	1,2,3,4,6,7,8-HpCDF	<2.4	<1.2	0.01	0.012	
	1,2,3,4,7,8,9-HpCDF	<0.28	<0.14	0.01	0.0014	
	OCDF	<3.5	<1.8	0.001	0.0018	
BACH-BC-09 - Totals	Total TCDF	<0.60	<0.20	0	0	
	Total PeDCF	<0.43	<0.15	0	0	
	Total HxCDF	<1.1	<0.22	0	0	
	Total HpCDF	<3.1	<0.65	0	0	
	Total TCDD	<0.43	<0.17	0	0	
	Total PeCDD	<0.32	<0.09	0	0	
	Total HxCDD	<1.6	<0.44	0	0	
	Total HpCDD	27		0	0	
Total Dioxins/Furans TEQ					**0.6827 ng/kg**	**<15 ng/kg**

J Estimate result. Result is < reporting limit. B Method blank contamination.
MDL = Method Detection Limit
TEQ = Toxicity Equivalency Quotient
TEF = Toxicity Equivalency Factors
*Guidance = Puget Sound Dredged Disposal Analysis (PSDDA) Program (Feb 2000) and U.S. EPA Toxicity Equivalency Factors (U.S. EPA 1989; Ahlborg et al. 1994)

Figure 1, Bachelor Slough Vicinity Map

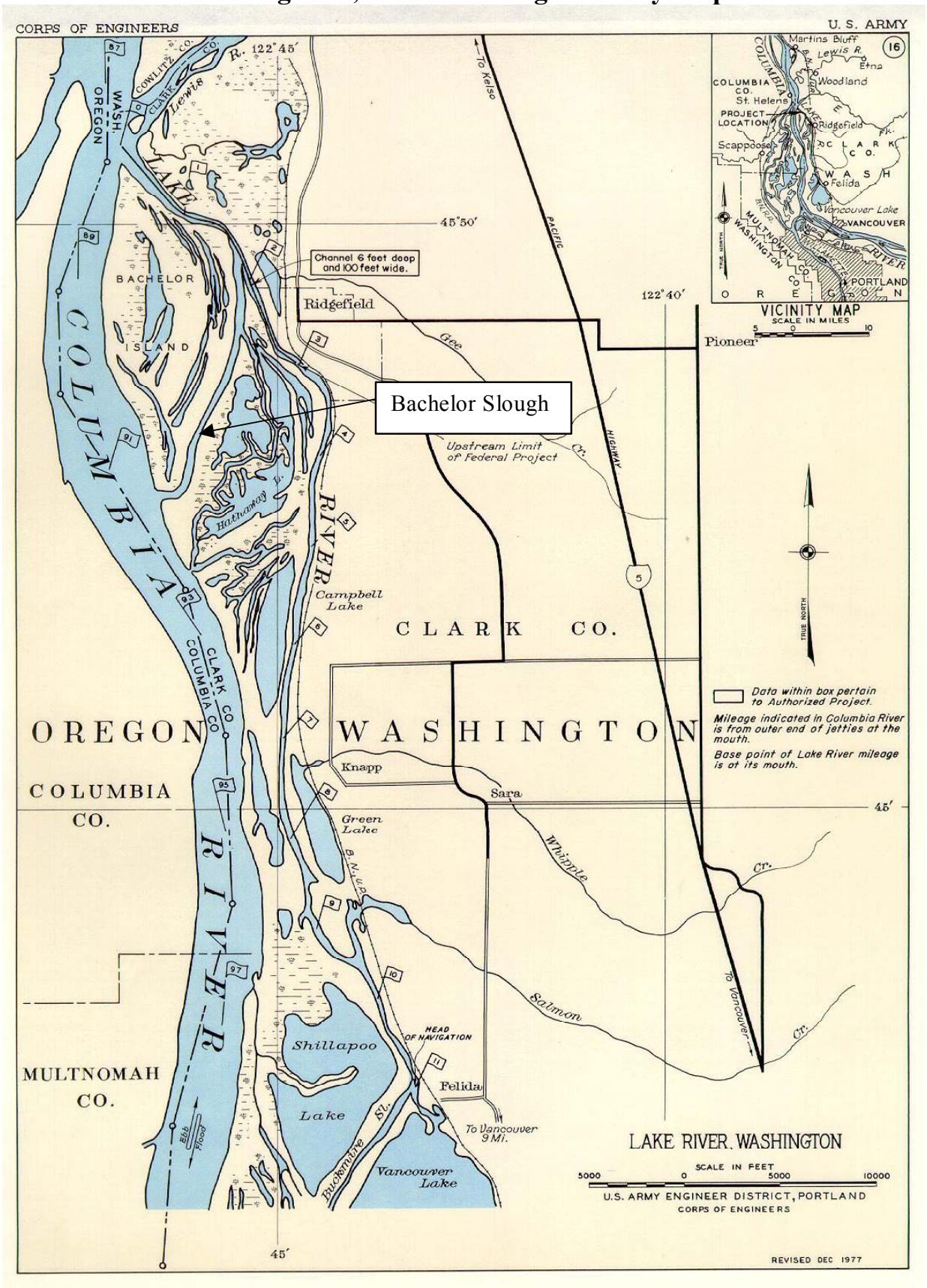

Figure 2, Bachelor Slough Sediment Sampling Station Locations